Abstract for Dissertation

Extended Artificial Bee Colony Algorithms for Continuous Optimization Problems
(連続最適化問題のための拡張人工蜂コロニーアルゴリズム)

Hai Shan

Swarm Intelligence (SI) is the collective behavior of decentralized, self-organized systems with natural or artificial ways as a discipline of artificial intelligence. Artificial bee colony (ABC) algorithm is one of the population based bio-inspired SI algorithms that inspired by the foraging behavior of honey bee colonies. ABC has attracted the researchers to make great contributions by modifying it in various ways. The modified ABC and hybridized ABC algorithms are superior to other algorithms in terms of its simplicity, flexibility and robustness when solving the numerical optimization problems, along with the advantages of the improved versions of ABC algorithm. The extended ABC algorithms of improved hybrid ABC (IHABC), levy flight-based hybrid ABC (LFHABC) and self adaptive enhanced hybrid ABC (SAHEABC) were proposed in the thesis in order to overcome the disadvantages, e.g., low convergence speed when they solving unimodal or composition functions, low exploitation abilities, and are also easily trapped in local optima when solving multi-modal functions, low diversity for initialization and lower fitness individuals hard to be selected as onlooker bees.

The comparative experiments for ABC, IHABC, DE and PSO algorithms were implemented for test functions defined by CEC'13 test suite. As the experimental results, IHABC and ABC algorithms were effective on unimodal function F1, IHABC outperformed than ABC algorithm, the convergence performance of IHABC was the best as a whole for multi-modal and composition functions, especially on 10D and 30D. ABC algorithm outperformed than DE and PSO algorithms, DE is better than PSO algorithm. Functions F1, F5, and F11 reached the best convergence performance with function errors of mean value of zero on 10D, 30D, and 50D.

Comparative experiments were implemented for LFHABC and SAHEABC to demonstrate the effectiveness of these algorithms. More specifically, CEC'13 was adopted by LFHABC and CEC'14 was utilized by SAHEABC. Through the comparison experiments of ABC, IABC, BsfABC, SHADE and NRGA algorithms, the results showed that SAHEABC was much effective for multi-modal functions, SAHEABC was the best for hybrid and composition functions, but not so significantly for hybrid functions. It was also observed that SAHEABC outperformed than ABC, BsfABC, IABC, SHADE and NRGA algorithms on those functions with the properties of non-separability, having huge local optima and second local optimum is far from the global optimum, having a narrow valley from local optimum to global optimum, having different properties around different local optima and variables subcomponents.